April 9, 1991
Narrative for Hebgen Lake Quadrangle
Dillon Resource Area Management Plan/EIS

Introduction

The Hebgen Lake Quadrangle (HLQ) is situated at the southeastern corner of the Dillon Resource Area (DRA) in Madison and Beaverhead counties.

The principal topographic features are the Gravelly Range in the north-western one-third of the HLQ, the north-south trending Madison River Valley east of the Gravelly Range, the Madison Range east of the Madison River Valley, the east-west Centennial Mountains along the Idaho state line at the southern edge of the map and the Centennial Valley north of the Centennial Mountains.

Structurally, the Gravelly Range, comprising about 9 townships, is a west dipping sequence of sedimentary rocks from Precambrian Archean age up into Cretaceous Montana Group age. Total thickness of the post Precambrian sediments is about 12,000 feet. The interval from the top of the Permian to top of Precambrian is about 5,000 feet. The primary targets for oil and gas exploration are probably in this interval. A thrust fault cuts the Gravelly Range from the northern part of T. 13 S., R. 3 W. through T. 10 S., R. 2 W. The surface trace of this fault is usually at, or near, the base of the Cretaceous Kootenai formation. The thrust plate has been segmented by northwest-southeast trending normal faults which also cut the footwall. Closed structural features, probably involving faulting can be expected in the foreland (footwall) and in the overthrusted block (hanging wall). Structural stacking of possible hydrocarbon traps may be defined which have a potential in both the overthrust hanging wall and the subthrust footwall in the same horizons.

There are no recent wells. In 1970 Union Texas Petroleum drilled the 1 Metzel-Federal, NW NW sec. 5, T. 13 S., R. 2 W. to a total depth of 4,125 feet into the Cambrian Park shale. Its surface elevation was 8,317 feet kelly bushing. Electric logs (gamma-ray & neutron) were run to only 3,655 feet due to the hole caving. It was spudded on an outcrop of Permian Shedhorn sandstone flanked on three sides by Tertiary volcanics. An apparently unfaulted sequence of Paleozoic sediments were drilled. The Permian Retort shale member of the Phosphoria formation was found at 94 to 150 feet. This important source bed may have been too shallow to develop much reservoir pressure or was open to surface exposure. Other source beds noted in this well are the Meade Peak shale member of the Permian Phosphoria formation at 340 feet, numerous shales in the Pennsylvanian in the lower Quadrant and Amsden formations including the Horseshoe shale member at the base of the Amsden. A significant thickness of upper Mississippian Big Snowy group sediments were drilled from 1,030-1,750 feet. These Chester age rocks are equivalent to the Heath, Otter and Kibbey formations of central Montana where they are considered to be source beds for overlying Pennsylvanian oil pools. Marine shales and carbonates make up most of the Mississippian Madisongroup from 1,750 to 3,550 feet. Reservoir beds at the Union Texas 1 Metzel-Federal locality, as indicated on the neutron log, are apparent in 6 or more thin intervals of 2 to 10 feet thick scattered through out the Mission Canyon from 1,815 of 2,770 feet. The top 100 feet of Pennsylvanian Quadrant may also be considered as a potential reservoir bed. The 270 feet thick Devonian Jefferson was not logged, (being covered by hole cavings) but probably contains some porous carbonates.

This is the only test well between the upper Ruby syncline and the Gravelly Arch an area of about 150,000 acres on the HLQ and nearly as large an area on the Ennis Quadrangle to the north.

The Madison River Valley crosses Ts. 10 & 11 S., Rs. 1 & 2 E. Gravity measurements (Schofield 1981) show the deepest part of this graben valley to be in T. 10 S., R. 1 E. about 2 miles east of U.S. 287. This generally north-south trending valley may possibly be intersected by a northeast-southwest trending graben that is obscured by Tertiary volcanics and Quaternary deposits. These masking sediments probably lie on Precambrian also, with Cretaceous through Cambrian rocks having been eroded away before the graben faulting occurred.

The south plunge of the Gravelly Arch is apparently transected by the east-west trending Centennial valley which is bordered, on the south, by the Centennial fault. This interpretation postulates an east-west fault parallel to the Centennial fault and 3 to 4 miles north of it.

The area south of the Centennial fault is apparently divided into 2 parts by the northeast-southwest trending Odell Creek fault. The east side of the Odell Creek fault (upthrown) features Precambrian to Cretaceous Thermapolis exposures. A southwest plunging anticline parallels the trace in T. 15 S., R. 2 W. Cross-faulting cuts the south plunge so that structural traps may have formed which separate prospective Paleozoic rocks from their outcrop areas, particularly in the NE NE sec. 14 where a well 4,200 feet deep would spud in Triassic rocks and test through the Cambrian.

The area west of the Odell Creek fault and south of the Centennial fault in Ts. 14 & 15 S., Rs. 2 & 3 W. is obscured by the Tertiary-Cretaceous Beaverhead formation and Tertiary volcanics. Potential structural traps should be present but at greater depths than east of the Odell Creek fault.

Occurrence Potential

Areas of Precambrian outcrops are classified as "VERY LOW" occurrence potential. These areas comprise about of the HLQ within the DRA.

Areas of 3,000 feet, or less, of post Precambrian sediments are classified as "LOW" potential except for where only Tertiary sediments are believed to rest upon Precambrian. These Tertiary areas are the Madison River Valley and a possible intersecting valley in Ts. 12 & 13 S., Rs. 1 E. & 1 W. Here, the "LOW" classification is taken down to a depth of 6,000 feet because of the less prospective nature of the sediments due to both composition and maturation.

Based on thickness and known source and reservoir rock presence, the remaining area is classified as of "MODERATE" occurrence potential. These areas include the major part of the Gravelly Range, the deeper part of the Madison River Valley and its postulated southwest intersect, the deeper part of the Centennial basin and much of the area south of the Centennial fault.

There are no areas of "HIGH" occurrence potential on the HLQ.

Development potential:

There are no lands on the HLQ considered to be of "HIGH" development potential.

The "VERY LOW" development potential includes the areas of Precambrian outcrops delineated on the occurrence potential map. It also includes a large area in the southern part of the HLQ within the boundaries of the Red Rock Lakes National Wildlife Refuge and the Centennial Mountains Primitive Area. No wells are anticipated within the "VERY LOW" classification in the upcoming 10 to 15 years.

Two areas of "MODERATE" development potential are delineated in the HLQ portion of the DRA. The smaller one, in Ts. 10 & 11 S., R. 1 E., consists of 11 square miles encompassing the deepest area in the Madison River Valley. Depth, to Precambrian is predicted, by gravitimeter, to be 15,000 feet, or more in this area which may have a more favorable temperature gradient than further north on the Ennis quadrangle. Only one exploratory well may be expected. If it is successful then about 10 development wells are anticipated, at a rate of 1 or 2 per year.

The large (4 to 5 townships) area in the northwest quarter of the HLQ is entirely on the Gravelly Range and in the Beaverhead National Forest. Two exploratory wells are expected in this area in the next 15 years, probably in federal units. A discovery well will generate an additional 15 to 20 wells.

The large area classified as "LOW" development potential may experience 1 or 2 wells in the next 15 years.

Total predicted wells to be drilled before the year 2006 are: 4 or 5 if all are dry, and 14 to 30 if one is a discovery.

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